4D-S
Transformational Memory Technology
Fitzroy Resources Limited
Presentation to Accompany Takeover Announcement
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Company Overview After Acquisition & Settlement

**Corporate Overview**

- **ASX Code (proposed)**: 4DS
- **Share Price**: $0.025
- **Market Cap**: $16m
- **Shares on Issue**: 659.2m*
- **Performance Shares**: 67.6m
- **Cash (post acquisition)**: $3.25m*

*assumes oversubscriptions of $500,000

**Technology — 4D-S MOHJO™**

- Next Generation Resistive Ram “ReRAM” (or RRAM).
- Non-volatile memory designed to supersede FLASH for mobile memory storage and cloud solid state device storage
- Established in 2007
- Based in Silicon Valley
- US$10m invested to date
- 19 US and International patents
- Advanced stage of technology development
- Joint Development Agreement with HGST, who helps organizations harness the power of data through a broad portfolio of proven, smarter storage solutions

**Company Board**

**Jim Dorrian**
- BA
- Chairman
- Has served as both CEO and Board Member of several Silicon Valley companies with in depth experience in M&A and IPOs. Former partner at Crosspoint Venture Partners

**Dr Guido Arnout**
- PhD
- CEO and Managing Director
- 30 years successfully building early stage electronics technology companies including Power-Escape, CoWare, CrossCheck Technology and Silvar-Lisco

**Howard Digby**
- BE (Hons)
- Non-Executive Director
- Former senior roles at IBM, Adobe, Gartner and the Economist Group. In Asia. Director of Sun Biomedical (ASX:SBN) and Estrella Resources (ASX:ESR)

**David McAulliffe**
- LLB (Hons), BPharm
- Non-Executive Director
- Experienced company director, has been involved in numerous capital raisings and in-licensing of technologies and founder of several companies in Australia, France and the UK, many of which are now publicly listed
Technology Overview

- Next generation non volatile memory. Disruptive technology for cloud storage and mobile devices

- Current mainstream technologies (mainly NAND “Flash” memory) have diminishing ability to scale further and meet future storage needs

- Potential to provide superior performance at fraction of power costs and heat
  - Electricity and cooling is the major operating cost of data centers
  - Power use and storage capacity is the major limiting factor of device thinness, heat output and battery life
Data Storage Today and in the Future

- 90% of data stored today was created in the last 2 years
  - Amazon Web Services, the world’s largest cloud provider, adds more server capacity every day than Amazon.com used to run its entire operations 10 years ago
- People, businesses use more and more data

Accumulated digital content per household

Source: Booz & Company

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The Memory Storage Problem

- Memory storage use growing exponentially
  - Cloud Storage banks made up of Solid State Drives (SSD)
  - Wearable technology
  - Mobile Devices
  - The internet of things – memory in normal devices

- Current technology – Flash memory cells can’t get much smaller and continue to hold more and more data while still remaining fast and reliable

- The solution?
  - Next generation memory that can store exponentially more data, is smaller, cooler, faster, uses less power and is more reliable
Different Memory for Different Uses

Volatile memory
- Requires power to store information
- DRAM and SRAM
- Such as Operative Memory, Cache

Non Volatile memory
- Stores information when the power is off
- Flash (NAND/NOR), EEPROM, NVSRAM
- Today’s mobile device memory: Phones, Tablets and Laptops
- Future storage: Cloud and Enterprise (SSDs) and Wearables

Emerging Non Volatile memory
- FeRAM, PCM, MRAM, CBRAM, ReRAM
Flash Memory Will Soon Hit a Wall. What Next?

- Of all the emerging memory storage technologies in development
  - ReRAM-based disruptive technologies have been cited and chosen by major semiconductor corporations and industry analysts as the best potential replacement for NAND Flash

4D-S is developing a transformative and disruptive ReRAM technology to replace Flash and address the massive memory storage demands of the future
What is ReRAM?

• Today’s NVM (e.g. Flash) – a “charge-based” technology
  o Moves and stores electrons
  o Data stored as charge
  o State of the art 2D NAND flash cells move and store as few as 8 electrons at a time
  o Laws of physics will provide a hard stop

• ReRAM: new transformational “material-based” memory technology
  o Changes resistance of switching material
  o Data stored as resistance
  o Potential for terabytes of storage in a single chip
  o Supports future mobile and cloud-based devices
How Does ReRAM Work?

An ReRAM cell consists switching material sandwiched between two electrodes

- A voltage pulse reversibly changes resistance (typically reversing voltage polarity)
- Resistance change establishes “On” and “Off”
- Switching materials range from simple (binary) metal oxides to multiple element composites
- Most ReRAMs create/eliminating conductive “filaments”
  - Either oxygen vacancy creation or metal injection into switching material
  - Filamentary conduction independent of cell size - potential future scaling issue
  - Poor “on” state retention if incomplete filament created
Why is 4D-S ReRAM Better?
No Filament…

- **4D-S MOHJO™**
  - Metal Oxide Hetero Junction – patented cell structure and operation
  - Oxygen exchange across hetero-junction
  - A voltage pulse reversibly changes resistance
  - Reversing voltage polarity switches resistance
  - Non-filamentary switching mechanism

- **4D-S patented ReRAM**
  - Inherently scales well beyond mainstream memories
  - Ideal candidate to replace Flash as dominant future non volatile memory

4D-S ReRAM technology is “non filamentary” – no filamentary scaling and retention issues
Potential to **store** exponentially **more** data than current NVM
  - More scalable than current memory technology’s cells
  - Readily configurable for future 3D implementation

Has demonstrated **higher performance** than existing NVM
  - More than 1000x faster read and write
  - Higher endurance
  - Better data retention
  - Lower energy

**Easy to manufacture**
  - Fewer steps than conventional memories (e.g. Flash)
  - Shows robust functionality, consistency and scalability

**Non filament – based**
  - Easier to control and to scale
  - A breakthrough in tackling a major hurdle facing ReRAM
• 2015 semiconductor memory market forecast to be greater than US$80 billion with 15% CAGR (Source: SIA, Gartner, IC Insights)

• Current high-density lower-power semiconductor memory market drivers
  - Mobile: smart-phones, tablets and laptops
  - SSD
By 2020, high-density lower-power semiconductor memory market drivers

- Enterprise storage, by far the largest
- Wearables, second largest
- Strong demand for low energy memory

* According to independent analyst research including surveys of user trends, memory usage and industry participants
Potential Partners — Memory Market Players

Five big companies control the memory business and will have a leading role in the development and adoption of emerging NVM. These companies are well poised to take advantage of what 4D-S is developing.

Source: Yole Development 2013

<table>
<thead>
<tr>
<th>Company</th>
<th>Market Cap</th>
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<tr>
<td>Samsung</td>
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<tr>
<td>Micron + Elpida</td>
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<tr>
<td>Macronix</td>
<td>$1bn</td>
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(¹Market share by revenue)
• Breakthrough inventions happen most often in high-tech startups

• Becoming a new high-volume high-density memory maker is virtually impossible
  o Need US$100m to design high-density ReRAM memory to be noticed
  o Requires US$10b to operate high-volume production fab

• Battleground therefore shifted from volume manufacturing to intellectual property (IP)
  o IP ownership by (or IP licensing to) established high-volume high-density memory makers
  o IP ownership by memory users to tailor to their mission critical needs

• Success is being at the center of the new battleground
  o Strength of IP best established by focusing on a specific market segment
  o What drives silicon storage today (mobile)
  o What is emerging as the biggest opportunity for silicon storage – the cloud

• Focused on addressing mission critical needs of the fastest growing market: the cloud
  o Hence, joint development agreement with leading storage company
Recent transactions
- Apple acquired Israeli SSD company Anobit for $390m in 2011
- Western Digital acquired storage startup Virident for $685m in 2013
- Seagate acquired Flash company LSI for $540m in 2014
- Western Digital acquired SSD company sTec for $340m in 2013

To attract a deal, NVM hopefuls must demonstrate their technology is:
- Scalable to super high-density
- Manufacturable with high yield
- Tunable to the mission critical needs of the key market segments
4D-S Advanced State of Development

- **2007 - 2013**: cell proof-of-concept in affordable geometries (16 patents)
  - i.e. basic memory cell technology works well
    - Patented filament-less ReRAM memory cell based on oxygen vacancies
    - Patented low-temperature deposition of essential memory material

- **2014 - current**: JDA with leading storage company to demonstrate technology is:
  - Scalable to super high-density
  - Manufacturable with high yield
  - Tunable to the mission critical needs of the “cloud”
  - Goal is to move the technology to a point where only “time and money” needed to productize

- Exit strategy is to be front and center in the IP battleground
- Capital raised will be used to undertake the final steps needed to achieve a high ROI exit
Investment Summary

- Massive and fast growing market. 4D-S is targeting the right segments at the right time: mobile & cloud
- Transformational and disruptive memory platform
- ReRAM technology stands out among other next generation players
- Joint Development Agreement with HGST, who helps organisations harness the power of data through a broad portfolio of proven, smarter storage solutions
- Success is licensing IP to memory makers or acquisition by memory maker or user

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